

CLAIMS

1. A machine tool having a material-remover, said material-remover having at least two degrees of freedom of movement, and at an instant being arranged to remove an amount of material, up to a depth of cut, from material that is being processed, processing circuitry being provided and arranged to control the movement of said material-remover, said processing circuitry determining a path along which said material-remover should move, and in determining said path said processing circuitry allowing said depth of cut made by the material-remover to vary.

2. The machine tool of claim 1 in which the machine is a milling machine.

3. The machine tool of claims 1 in which the material remover of the machine tool is arranged to rotate about an axis.

4. The machine tool of claim 1 in which the processing circuitry is arranged to attempt to move the material remover such that the magnitude of its velocity is roughly constant.

5. The machine tool of claim 1 in which the processing circuitry comprises a track planner arranged to associate one or more tracks around the perimeter of an object to be machined, and the or each said track comprising a locus of all the possible material remover paths around the object.

6. The machine tool of any of claim 1 in which the processing circuitry comprises a track planner arranged to associate one or more contours around the perimeter of an object to be machined, the or each said contour comprising a locus of all the possible material remover paths around the object.

7. The machine tool of claim 5 in which the track planner produces tracks that are of variable width.
- 5 8. The machine tool of claim 5 in which the processing circuitry further comprises a node associator arranged to associate a number of nodes with predetermined points around the track and/or contour that has been calculated.
- ATB*
- 10 9. The machine tool of claim 8 in which the node associator is arranged to associate points with corners of the track and/or contour.
fine
10. The machine tool of claim 8 in which the node associator is arranged to associate predetermined nodes with the inside of the track.
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AB not inherently closed track
11. The machine tool of claim 10 in which the node associator is arranged to associate other predetermined nodes with the outside of the track.
- 20 12. The machine tool of claims 8 in which the processing circuitry further comprises a curve associator arranged to associate a curve with each of the nodes produced by the node associator.
13. The machine tool of claim 12 in which the curve associated with the node by the curve associator has a radius corresponding to the minimum radius of a path of the material remover of the machine tool.
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14. The machine tool of claim 12 in which the curve associator is arranged to reduce the radius of one or more curves if curves centred on opposite sides of the track intersect one another to block the track.
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15. The machine tool of claim 12 in which the curve associator is arranged to associate more than one node with any one curve.
16. The machine tool claim 12 in which the curves are situated at the 5 nodes generated by the node associator such that the radius of the curve passes close to the node.
17. The machine tool of claim 12 in which the curve association is arranged to associate circles, or portions of circles with the nodes.
- 10 18. The machine tool of claims 12 in which the processing circuitry further comprises a tangent generator arranged to associate a path between each of the curves that it contacts.
- 15 19. The machine tool of claim 18 in which the processing circuitry is arranged to convert the tangents generated by the tangent generator together with portions of the curves provided by the curve associator into a path for the material remover.
- 20 20. The machine tool of claim 1 in which the processing circuitry is arranged to generate paths that form a closed loop around the object to be fabricated.
- 25 21. The machine tool of claim 1 in which the processing circuitry is arranged to produce a series of paths such that an object can be fabricated from a block of material.
- 30 22. —A method of removing material from a block of material to fashion an object therefrom, said method comprising plotting a path for a material remover of a machine tool, said path being optimised by allowing the depth of a cut made by the material remover to vary.

*No structure
Plotting
could
be some
would*

23. The method of claim 22 in which an attempt is made to move the material remover at roughly a constant speed.
24. The method of claim 22 which further comprises calculating a track around the perimeter of an object to be machined.
- 5 25. The method of claim 22 which further comprises calculating a contour around the perimeter of an object to be machined, displaced from the object by a predetermined amount.
- 10 26. The method of claim 24 in which a plurality of contours and/or tracks are built up around the perimeter of the object to be fabricated, each of said contours and/or tracks providing an indication of the material that is possible for the material remover to remove in a series of passes.
- 15 27. The method of claim 24 which further comprises associating a number of nodes with predetermined points around the track and/or contour previously calculated.
- 20 28. The method of claim 27 which further comprises associating predetermined nodes with the inside of the track previously determined.
- 25 29. The method of claim 28 which further comprises associating predetermined nodes with the outside of the track previously determined.
30. The method of claim 27 which further comprise associating a curve with each of the nodes previously generated.
- 30 31. The method of claim 30 in which the curve has a radius corresponding to the minimum cutting radius of the material remover of the machine tool.

32. The method of claim 30 in which the curve is arranged at the nodes such that the radius of the curve passes close to the node.
33. The method of claim 30 which further comprises plotting a path comprising a tangent between each of the curves, together with a portion of one or more of the curves.
34. The method of claims 30 which further comprises reducing the radii of curves associated with the nodes if the curve extends beyond the track.
35. The method of claims 22 which generates one or more paths that form closed loops around the object to be fabricated.
36. A computer readable medium coded with instructions to cause a computer to perform the method of claim 22.
- 112 - some of steps are for machine tool*
37. A computer readable medium coded with instructions that when loaded into a machine tool cause it to function as claimed in claim 1.
- 112 2nd → cl. 1
not claim to method*
38. A machine tool having a material-removing means, said material-removing means having at least two degrees of freedom of movement, and at an instant being arranged to remove an amount of material, up to a depth of cut, from material that is being processed, processing circuitry being provided and arranged to control the movement of said material-removing means, said processing circuitry determining a path along which said material-removing means should move, and in determining said path said processing circuitry allowing said depth of cut made by the material-removing means to vary. *WIP means -- only diff from cl. 1*
39. A machine tool having a material-remover, said material-remover having at least two degrees of freedom of movement, and at an instant being arranged to remove an amount of material, up to a depth of cut, from

- material that is being processed, processing circuitry being provided and arranged to control the movement of said material-remover, said processing circuitry determining a path along which said material-remover should move, and in determining said path said processing circuitry allowing said
- 5 depth of cut made by the material-remover to vary the processing circuitry further comprising a track planner arranged to associate one or more contours around the perimeter of an object to be machined, the or each said contour comprising a locus of all the possible material remover paths around the object, the processing circuitry further comprises a node associator arranged to associate a number of nodes with predetermined points around the ^{contour} ~~track~~ that has been ^{calculated} associated, the processing circuitry further comprises a curve associator arranged to associate a curve with each of the nodes produced by the node associator, the processing circuitry further comprises a tangent generator arranged to associate a path between
- 10 15 each of the curves generated by the curve associator wherein the processing circuitry is arranged to convert the tangents generated by the tangent generator together with portions of the curves provided by the curve associator into a path for the material remover.
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- 20 40. A method of removing material from a block of material to fashion an object therefrom, said method comprising plotting a path for a material removing means of a machine tool, said path being optimised by allowing the depth of a cut made by the material removing means to vary.
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